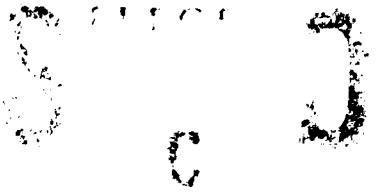

OFFICE OF NAVAL RESEARCH

QUARTERLY REPORT

for

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GRANT No. : N00014-89-J-1754

THE EFFECTS OF MAGNETIC STORM PHASES ON F-LAYER IRREGULARITIES FROM AURORAL TO EQUATORIAL LATITUDES

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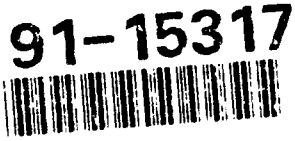

VISIT

In our last quarterly report we noted that a visit from Dr. Leonard Kersley of the University College of Aberystwyth was expected. Dr. Kersley during this period, on July 2nd, visited Boston University to discuss the possible further data reduction of data sets for low and high solar flux years. Some reduction of data has taken place on our part with Goose Bay observations at 70° Corrected Geomagnetic Latitude compared for the years 1980 and 1985. In the interim we have developed a contouring program to handle the data and in fact have received data from a sample period of very low magnetic activity over a period of several days. We have just begun this study of determining the pattern of F-layer irregularities during years of low solar flux. The evaluation of data sets has included new analysis (for Manila, for example) as well as evaluating older data, some of it unpublished.

STUDIES

Determining the morphology of equatorial F-layer irregularities as a function of longitude is vital for understanding the physics of the development of these irregularities. We are evaluating the observational basis which then can be used to test theoretical models. Satellite in-situ data, scintillation and spread F observations have been reviewed. The limitation of each data set is being set forth. The questions to be answered as to the physics of the longitudinal aspects of the morphology are (1) why do the equinox months have high levels of occurrence over all longitudes and (2) why are there relatively high levels of occurrence in the Pacific Sector in the July-August period and in the 0-75* West sector in the November-December period (3) why are there very low levels of occurrence in November and December in the Pacific Sector and in July and August in the 0-75* West Sector. A cartoon as to the occurrence pattern, as we see it, as a function of longitude, is in early stages of development.

A paper on the morphology of equatorial irregularities relative to their generation is being prepared for the AGARD Symposium on Radio Location Techniques to be held in London, UK 1-5 June 1992. Since the Global Positioning System as well as HF Direction Finding is affected by transmission thru the equatorial ionosphere, a paper on the morphology of equatorial irregularities appeared to be in order. The abstract has been cleared by ONR and send to Dr. J. Richter, the Program Director of the symposium. The previous paper for AGARD in the 1990 symposium, had to do with dynamics of real time forecasting during magnetic disturbances. This paper has to do with the magnetically quiet periods; the study will encompass global effects.

A paper entitled "Onset conditions for equatorial spread-F" has been developed by Michael Mendillo, Jeffrey Baumgardner, Xiaoqing Pi, Peter J. Sultan of the Center for Space Physics and by Roland Tsunoda of SRI International. The paper has been submitted to the Journal of Geophysical Research.

Addressing problems relative to the grant the abstract is as follows: The problem of day-to-day variability in the occurrence of equatorial spread-F (ESF) is addressed using multi-diagnostic observations and semi-empirical modeling. The observational results are derived from a two-night case study of ESF onset conditions observed at Kwajalein Atoll (Marshall Islands) using the ALTAIR incoherent scatter radar and all-sky optical imaging techniques.

The major difference between nights when ESF instabilities did not occur (14 August 1988) and did occur (15 August 1988) in the Kwajalein sector was that the northern meridional gradient of 6300Å airglow was reduced on the night of limited ESF activity. Modeling results suggest that this unusual airglow pattern is due to equatorward neutral winds. Previous researchers have shown that trans-equatorial thermospheric winds can exert a control over ESF seasonal and longitudinal occurrence patterns by inhibiting Rayleigh-Taylor instability growth rates. We present evidence to suggest that this picture can be extended to far shorter time scales, namely, that "surges" in trans-equatorial winds acting over characteristic times of a few hours to a day can result in a stabilizing influence upon irregularity growth rates. The seemingly capricious nature of ESF onset may thus be controlled, in part, by the inherent variability of low latitude thermospheric winds.

PUBLICATION

During this quarter the following paper was published by Annales Geophysicae:

J. Aarons, J.C. Foster (Atmospheric Sciences Group of the Haystack Observatory) and A.S. Rodger (British Antarctic Survey). Auroral and sub-auroral F-layer irregularities and high plasma convection during the magnetically active periods of September 17-24, 1984